Claims

[c1] 1. A method of quenching a material, comprising the steps of:

providing a material having a first section and a second section; and

propelling a fluid against said first section to increase a cooling rate of said first section relative to a cooling rate of said second section.

[c2] 2. The method as recited in claim 1, wherein said fluid comprises a gas.

[c3] 3. The method as recited in claim 1, wherein said propelling step generally minimizes a gradient between a temperature of said first section and a temperature of said second section.

[c4] 4. The method as recited in claim 1, wherein the propelling step comprises impinging said fluid against said first section to provide impingement cooling at said first section.

[c5] 5. The method as recited in claim 1, wherein the propelling step remains constant during quenching.

[c6] 6. The method as recited in claim 1, wherein the propelling step varies during quenching.

[c7] 7. The method as recited in claim 6, wherein the propelling step varies by adjusting a pressure of said fluid.

[c8] 8. A method of adjusting the cooling rate of a forging during quenching, comprising the steps of:

providing a forging having a first section with a first cooling rate and a second section having a second cooling rate; and

propelling a fluid against said first section in order to minimize a differential between said first cooling rate and said second cooling rate.

[c9] 9. The method as recited in claim 8, wherein said fluid is a gas.

[c10] 10. The method as recited in claim 8, wherein said propelling step generally minimizes a gradient between a temperature of said first section and a temperature of said second section.

[c11] 11. The method as recited in claim 8, wherein the propelling step comprises impinging said fluid against said first section to provide impingement cooling at said first section.

[c12] 12. The method as recited in claim 8, wherein the propelling step remains constant during quenching.

[c13] 13. The method as recited in claim 8, wherein the propelling step varies during quenching.

[c14] 14. The method as recited in claim 13, wherein the propelling step varies by adjusting a pressure of said fluid.

[c15] 15. An apparatus for quenching a material, the material having a first section and a second section, said apparatus comprising:

a support for receiving the material; and

an outlet adjacent said support for impinging a fluid against the first section of the material, so that a cooling rate of the first section increases relative to a cooling rate of the second section.

[c16] 16. The apparatus as recited in claim 15, wherein said outlet has a diameter (d) and is positioned a distance (Z) from the material placed in said support, and Z/d is between approximately 1.0 and 6.0.

[c17] 17. The apparatus as recited in claim 15, wherein said outlet comprises a plurality of outlets each having a diameter (d), adjacent outlets having a spacing (s) therebetween, and s/d is less than approximately 26.0.

[c18] 18. The apparatus as recited in claim 17, wherein said spacing is a circumferential spacing (X) and X/d is less than approximately 26.0.

[c19] 19. The apparatus as recited in claim 17, wherein said spacing is a radial spacing (Y) and Y/d is less than approximately 24.0.

[c20] 20. The apparatus as recited in claim 15, wherein said outlet comprises a plurality of outlets in an annular pipe.